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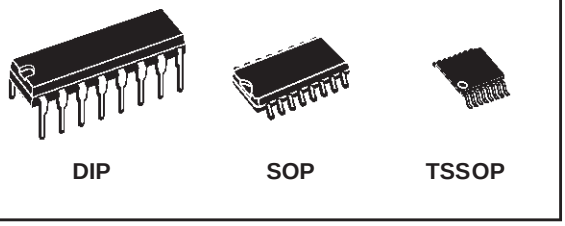
M74HC4051

SINGLE 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- LOW POWER DISSIPATION:
  I_{CC} = 4μA(MAX.) at T_A=25°C
- LOGIC LEVEL TRANSLATION TO ENABLE 5V LOGIC SIGNAL TO COMMUNICATE WITH ±5V ANALOG SIGNAL
- LOW "ON" RESISTANCE:
  70Ω TYP. (V_{CC} - V_{EE} = 4.5V)
  50Ω TYP. (V_{CC} - V_{EE} = 9V)
- WIDE ANALOG INPUT VOLTAGE RANGE: ±6V
- FAST SWITCHING:
  t_{pd} = 15ns (TYP.) at T_A = 25 °C
- LOW CROSSTALK BETWEEN SWITCHES
- HIGH ON/OFF OUTPUT VOLTAGE RATIO
- WIDE OPERATING SUPPLY VOLTAGE RANGE (V_{CC} - V_{EE}) = 2V TO 12V
- LOW SINE WAVE DISTORTION:
  0.02% at V_{CC} - V_{EE} = 9V
- HIGH NOISE IMMUNITY:
  V_{NIH} = V_{NIL} = 28 % V_{CC} (MIN.)
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 4051



ORDER CODES

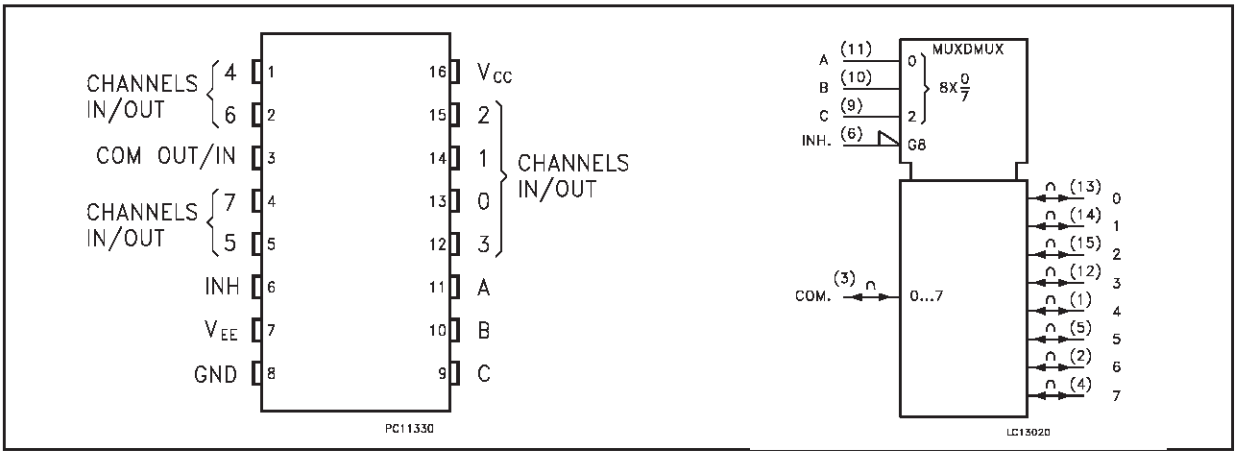
PACKAGE	TUBE	T & R
DIP	M74HC4051B1R	
SOP	M74HC4051M1R	M74HC4051RM13TR
TSSOP		M74HC4051TTR

DESCRIPTION

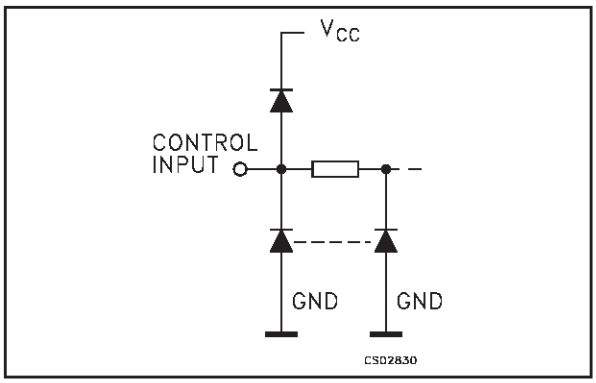
The M74HC4051 is a single eight-channel analog MULTIPLEXER/DEMULTIPLEXER fabricated with silicon gate C^2MOS technology and it is pin to pin compatible with the equivalent metal gate CMOS4000B series.

It contains 8 bidirectional and digitally controlled analog switches.
A built-in level shifting is included to allow an input range up to ±6V (peak) for an analog signal with digital control signal of 0 to 6V.
V_{EE} supply pin is provided for analog input signals. It has an inhibit (INH) input terminal to disable all the switches when is at high level. For operation as a digital multiplexer/demultiplexer, V_{EE} is connected to GND.
A, B and C control inputs select one channel out of eight.
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

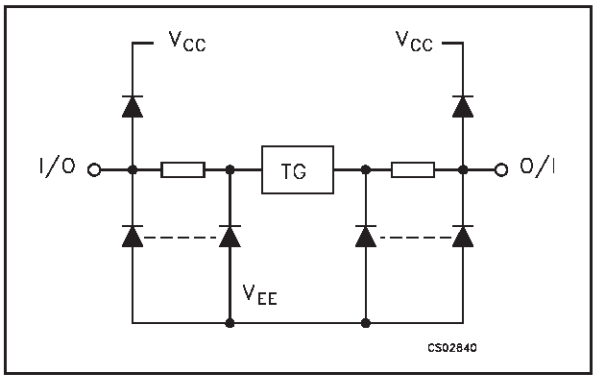
PIN CONNECTION AND IEC LOGIC SYMBOLS



CONTROL INPUT EQUIVALENT CIRCUIT



I/O EQUIVALENT CIRCUIT



PIN DESCRIPTION

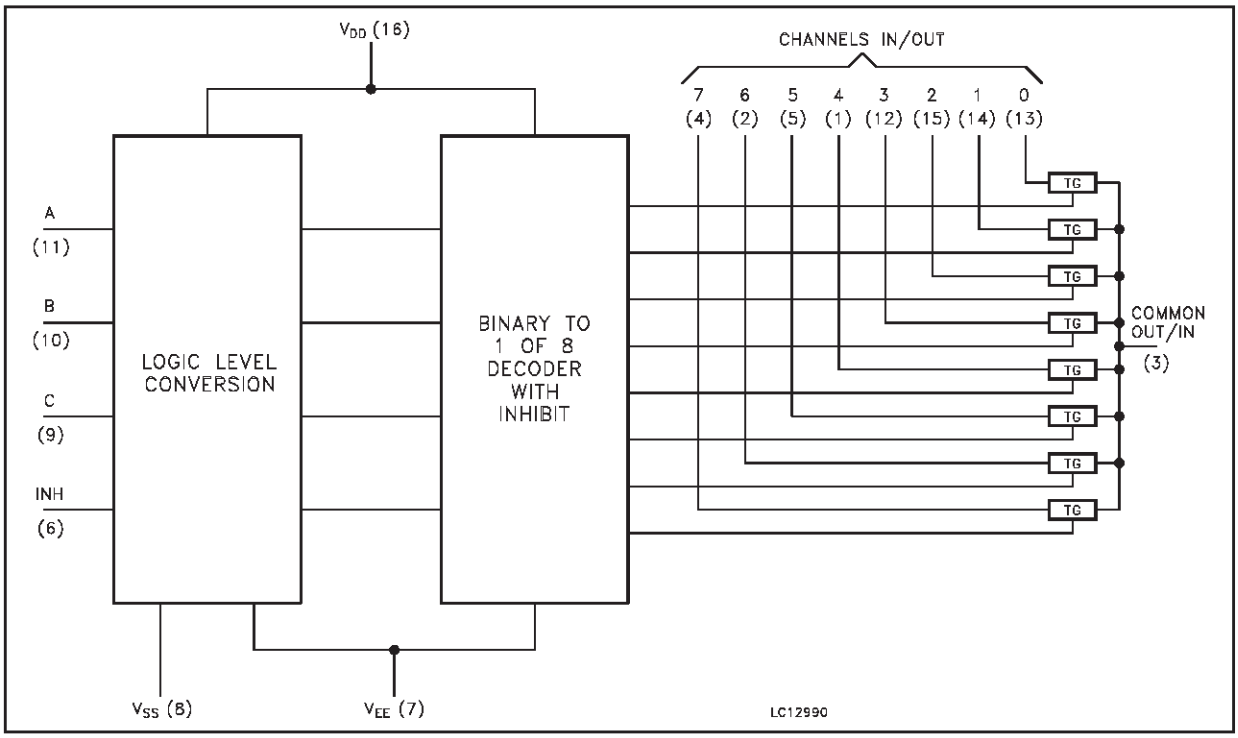
PIN No	SYMBOL	NAME AND FUNCTION
3	COM OUT/IN	Common Output/Input
6	INH	INHIBIT Input
7	V_{EE}	Negative Supply Voltage
11, 10, 9	A, B, C	Select Inputs
13, 14, 15, 12, 1, 5, 2, 4	0 to 7	Independent Input/Outputs
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

TRUTH TABLE

INPUT STATE				ON CHANNEL
INH	C	B	A	
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	X	X	X	NONE

X: Don't care

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7	V
V_{CC} - V_{EE}	Supply Voltage	-0.5 to +13	V
V_I	Control Input Voltage	-0.5 to V_{CC} + 0.5	V
$V_{I/O}$	Switch I/O Voltage	V_{EE} -0.5 to V_{CC} + 0.5	V
I_{CK}	Control Input Diode Current	± 20	mA
I_{IOK}	I/O Diode Current	± 20	mA
I_T	Switch Through Current	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500(*)	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		2 to 6	V
V_{EE}	Supply Voltage		-6 to 0	V
V_{CC} - V_{EE}	Supply Voltage		2 to 12	V
V_I	Input Voltage		0 to V_{CC}	V
$V_{I/O}$	I/O Voltage		V_{EE} to V_{CC}	V
T_{op}	Operating Temperature		-55 to 125	°C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2.0V	0 to 1000	ns
		V_{CC} = 4.5V	0 to 500	
		V_{CC} = 6.0V	0 to 400	

DC SPECIFICATIONS

Symbol	Parameter	Test Condition			Value							Unit
		V_{CC} (V)	V_{EE} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IHC}	High Level Input Voltage	2.0			1.5			1.5		1.5		V
		4.5			3.15			3.15		3.15		
		6.0			4.2			4.2		4.2		
V_{ILC}	Low Level Input Voltage	2.0					0.5		0.5		0.5	V
		4.5					1.35		1.35		1.35	
		6.0					1.8		1.8		1.8	
R_{ON}	ON Resistance	4.5	GND	$V_I = V_{IHC}$ or V_{ILC} $V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O} \leq 2mA$		85	180		225		270	Ω
		4.5	-4.5			55	120		150		180	
		6.0	-6.0			50	100		125		150	
		2.0	GND	$V_I = V_{IHC}$ or V_{ILC} $V_{I/O} = V_{CC}$ or V_{EE} $I_{I/O} \leq 2mA$		150						
		4.5	GND			70	150		190		230	
		4.5	-4.5			50	100		125		150	
		6.0	-6.0			45	80		100		120	
ΔR_{ON}	Difference of ON Resistance between switches	4.5	GND	$V_I = V_{IHC}$ or V_{ILC} $V_{I/O} = V_{CC}$ or V_{EE} $I_{I/O} \leq 2mA$		10	30		35		45	Ω
		4.5	-4.5			5	12		15		18	
		6.0	-6.0			5	10		12		15	
I_{OFF}	Input/Output Leakage Current (SWITCH OFF)	6.0	GND	$V_{OS} = V_{CC}$ or GND V_{IS} = GND or V_{CC} $V_I = V_{ILC}$ or V_{IHC}			±0.06		± 0.6		± 1.2	µA
		6.0	-6.0				± 0.1		± 1		± 2	
I_{IZ}	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	$V_{OS} = V_{CC}$ or GND $V_I = V_{IHC}$ or V_{ILC}			±0.06		± 0.6		± 1.2	µA
		6.0	-6.0				± 0.1		± 1		± 2	
I_I	Input Leakage Current	6.0	GND	$V_I = V_{CC}$ or GND			± 0.1		± 0.1		± 1	µA
I_{CC}	Quiescent Supply Current	6.0	GND	$V_I = V_{CC}$ or GND			4		40		80	µA
		6.0	-6.0				8		80		160	

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6ns)

Symbol	Parameter	Test Condition			Value							Unit
		V_{CC} (V)	V_{EE} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
$\Phi_{I/O}$	Phase Difference Between Input and Output	2.0	GND			25	60		75		90	ns
		4.5	GND			6	12		15		18	
		6.0	GND			5	10		13		15	
		4.5	-4.5			4						
t_{PZL} t_{PZH}	Output Enable Time	2.0	GND	R_L = 1KΩ		64	225		280		340	ns
		4.5	GND			18	45		56		68	
		6.0	GND			15	38		48		58	
		4.5	-4.5			18						
t_{PLZ} t_{PHZ}	Output Disable Time	2.0	GND	R_L = 1KΩ		100	250		315		375	ns
		4.5	GND			33	50		63		70	
		6.0	GND			28	43		54		64	
		4.5	-4.5			29						

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition			Value							Unit
		V_{CC} (V)	V_{EE} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
C_{IN}	Input Capacitance	5.0				5	10		10		10	pF
$C_{I/O}$	Common Terminal Capacitance	5.0	-5.0			36	70		70		70	pF
$C_{I/O}$	Switch Terminal Capacitance	5.0	-5.0			7	15		15		15	pF
C_{IOS}	Feed Through Capacitance	5.0	-5.0			0.95	2		2		2	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0	GND			70						pF

1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

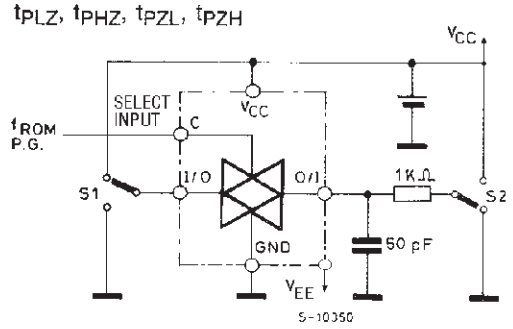
ANALOG SWITCH CHARACTERISTICS (GND = 0V; T_A = 25°C)

Symbol	Parameter	Test Condition				Value	Unit
		V_{CC} (V)	V_{EE} (V)	V_{IN} (V_{p-p})		Typ.	
	Sine Wave Distortion	2.25	-2.25	4	f_{IN} = 1 KHz R_L = 10 KΩ C_L = 50 pF	0.025	%
		4.5	-4.5	8		0.020	
		6.0	-6.0	11		0.018	
f_{MAX}	Frequency Response (Switch ON) (*)	2.25	-2.25	Adjust f_{IN} voltage to obtain 0 dBm at V_{OS}. Increase f_{IN} Frequency until dB meter reads -3dB R_L = 50Ω, C_L = 10 pF, f_{IN} = 1KHz sine wave		120	MHz
		4.5	-4.5			190	
		6.0	-6.0			200	
f_{MAX}	Frequency Response (Switch ON) (**)	2.25	-2.25	Adjust f_{IN} voltage to obtain 0 dBm at V_{OS}. Increase f_{IN} Frequency until dB meter reads -3dB R_L = 50Ω, C_L = 10 pF, f_{IN} = 1KHz sine wave		45	MHz
		4.5	-4.5			70	
		6.0	-6.0			85	
	Feed through Attenuation (Switch OFF)	2.25	-2.25	V_{IN} is centered at (V_{CC} - V_{EE})/2 Adjust input for 0 dBm R_L = 600Ω, C_L = 50 pF, f_{IN} = 1KHz sine wave		-50	dB
		4.5	-4.5			-50	
		6.0	-6.0			-50	
	Crosstalk (Control Input to Signal Output)	2.25	-2.25	Adjust R_L at set up so that I_S = 0A. R_L = 600Ω, C_L = 50 pF, f_{IN} = 1KHz square wave		60	mV
		4.5	-4.5			140	
		6.0	-6.0			200	
	Crosstalk (between any two Switches)	2.25	-2.25	Adjust V_{IN} to obtain 0dBm at input R_L = 600Ω, C_L = 50 pF, f_{IN} = 1KHz sine wave		-50	dB
		4.5	-4.5			-50	
		6.0	-6.0			-50	

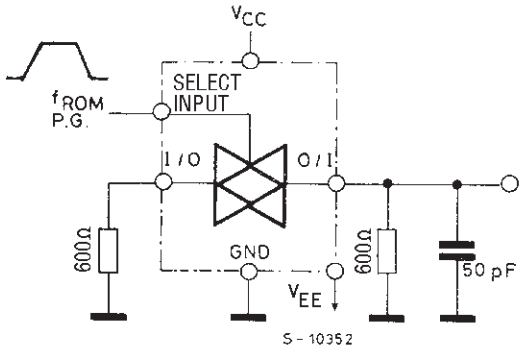
(*) Input COMMON Terminal, and measured at SWITCH Terminal
(**) Input SWITCH Terminal, and measured at common Terminal
NOTE: These characteristics are determined by the design of the device.

SWITCHING CARACTERISTICS TEST CIRCUIT

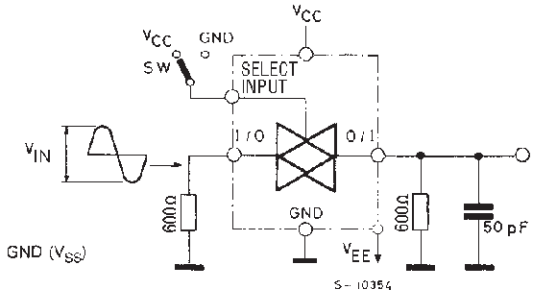
t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}



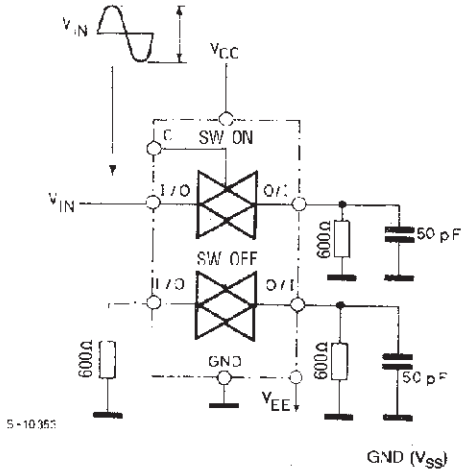
CROSSTALK (control to output)



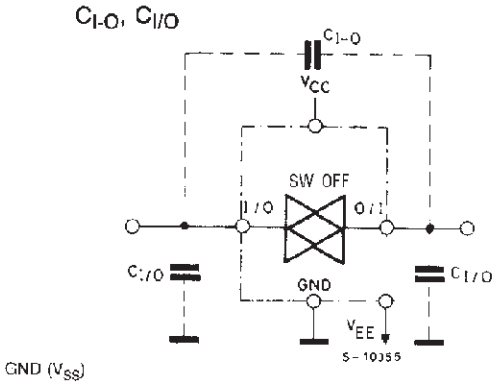
BANDWIDTH AND FEEDTHROUGH ATTENUATION



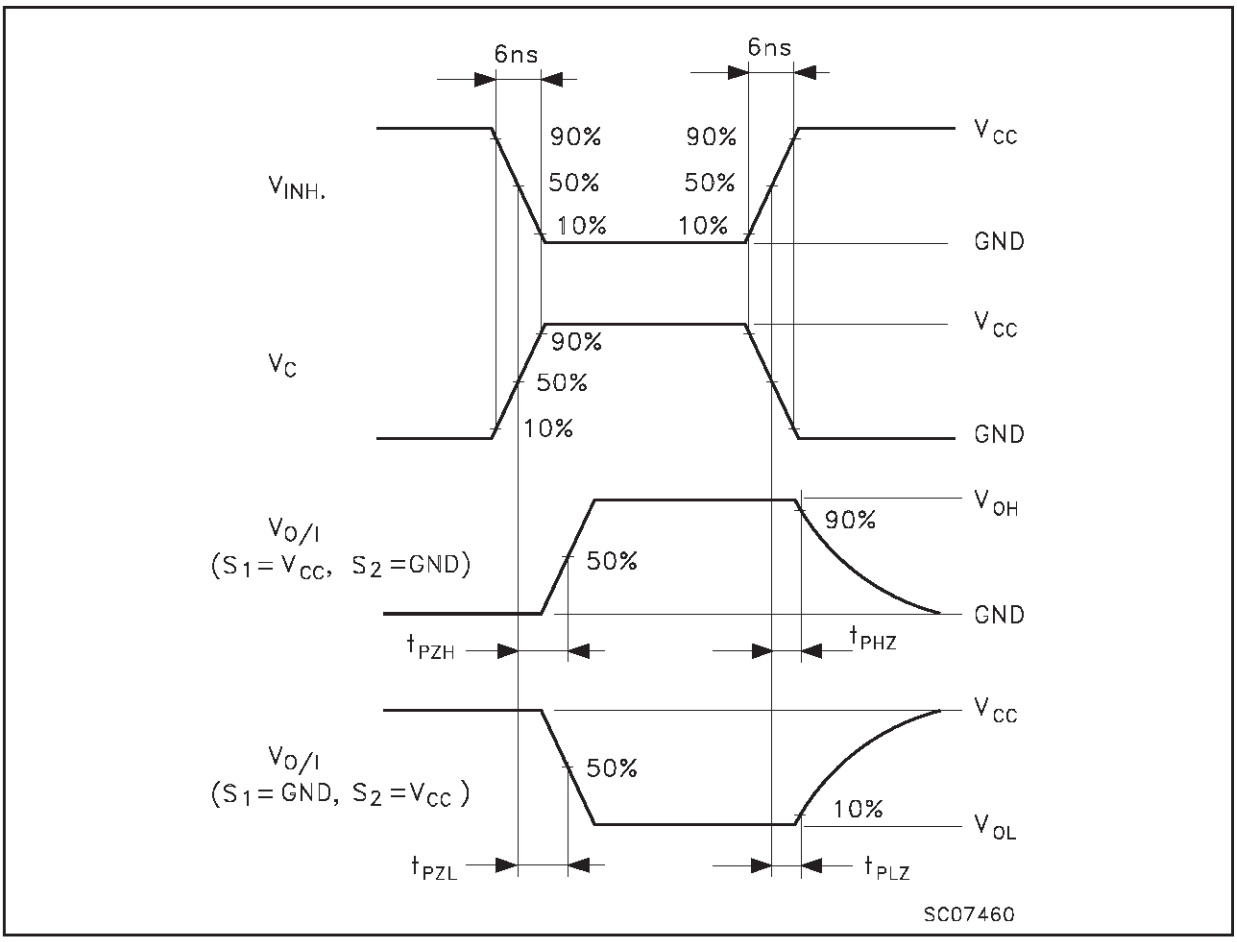
CROSSTALK BETWEEN ANY TWO SWITCHES



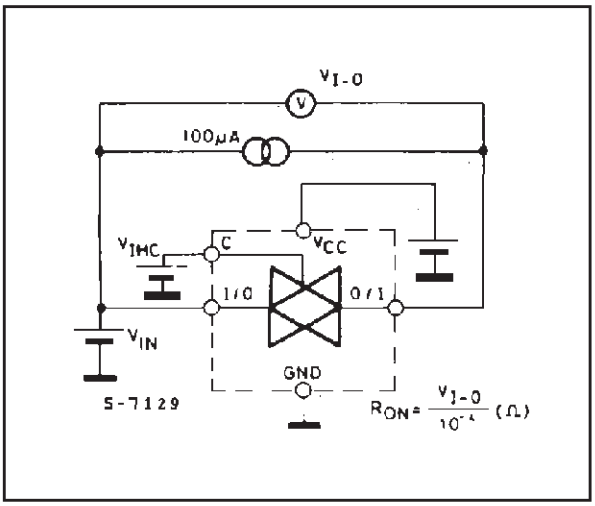
C_{I-O}, $C_{I/O}$



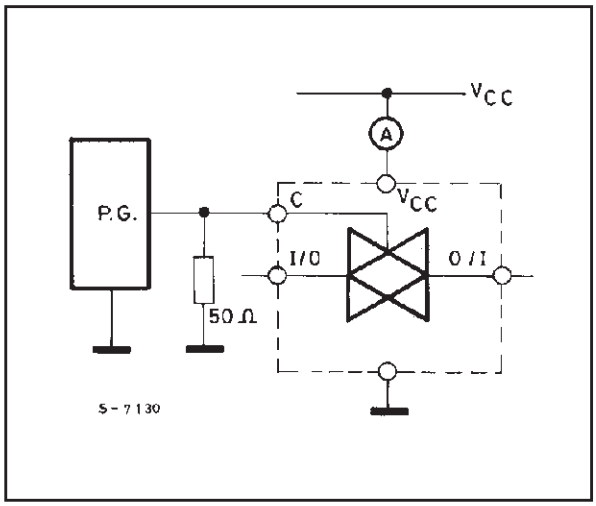
SWITCHING CHARACTERISTICS WAVEFORM



CHANNEL RESISTANCE (R_{ON})

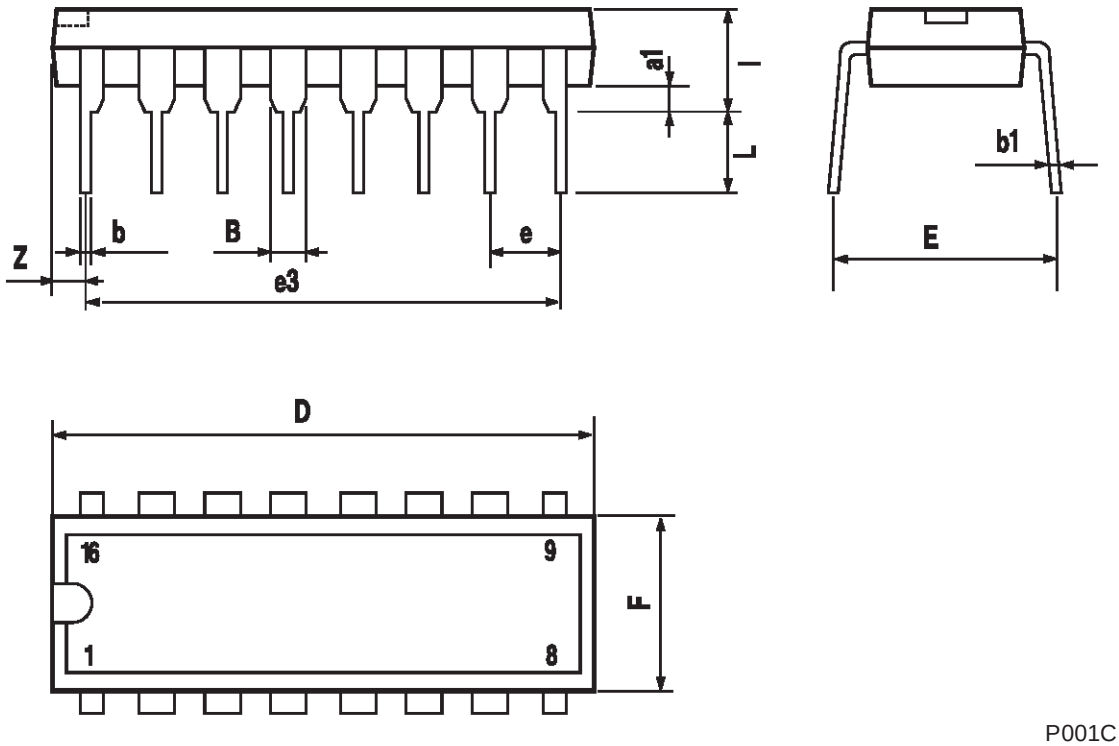


I_{CC} (Opr.)



Plastic DIP-16 (0.25) MECHANICAL DATA

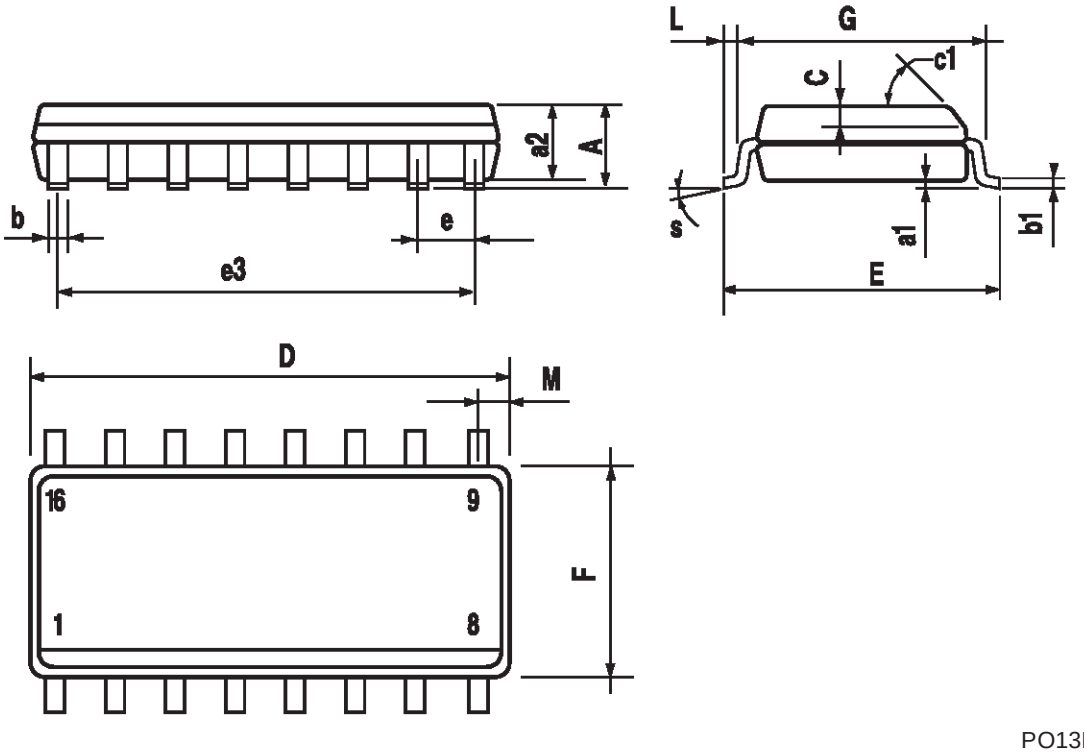
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

SO-16 MECHANICAL DATA

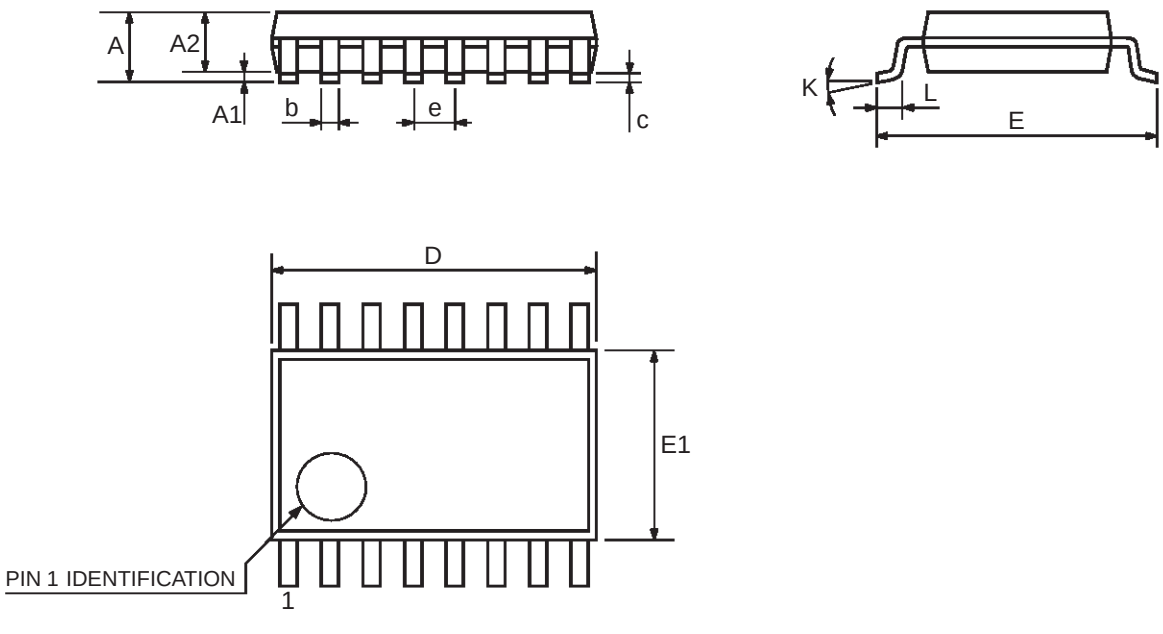
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



PO13H

TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



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